basis for approval of industrial plants in Alberta

Alberta
ENVIRONMENT

BASIS FOR APPROVAL
OF INDUSTRIAL PLANTS
IN ALBERTA

STANDARDS AND APPROVALS

ALBERTA ENVIRONMENT

JULY, 1983

BASIS FOR APPROVAL OF INDUSTRIAL PLANTS IN ALBERTA

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I. INTRODUCTION

To appreciate the approach used in Alberta to maintain acceptable environmental quality, it is important that industry and the public understand the basis of the pollution control program. The program consists of approving industrial contaminant discharges and enforcing the approvals and environmental control regulations to provide adequate protection of the environment.

The Department has two objectives to be realized by the approval process; one is to minimize the amount of contaminants discharged from industrial sources and the second is to maintain a pre-determined ambient air quality and surface water quality.

Control of contaminants at the sources is based on implementation of best practicable technology or best available technology.

Maintenance of ambient air quality is achieved by providing adequate dispersion of contaminants to achieve a specific maximum calculated ground level concentration. This calculation takes in to account the amount of contaminant, stack height, wind speed, stack exit temperature, and the worst meteorological conditions for dispersions.

Ambient water quality is that quality that exists in the receiving stream after complete mixing or assimilation of the contaminant has occurred. The approval of water contaminant discharged to receiving streams takes in to consideration site specific factors such as stream flow volume, proximity to downstream users, recreational uses, etc.

The following tables summarize the basis for the approval process.

II. BASIS FOR AMBIENT AIR QUALITY

CONTAMINANT	MAXIMUM CALCULATED GROUND LEVEL CONCENTRATION[1,19]	FEDERAL AMBIENT AIR QUALITY OBJECTIVES[2]								
		MAXIMUM DESIRABLE LEVEL			MAXIMUM ACCEPTABLE LEVEL			MAXIMUM TOLERABLE LEVEL		
	HOURLY AVERAGE ug/m^3 (ppm)	HOURLY AVERAGE ug/m^3 (ppm)	24-HOUR AVERAGE ug/m^3 (ppm)	ANNUAL AVERAGE ug/m^3 (ppm)	HOURLY AVERAGE ug/m^3 (ppm)	24-HOUR AVERAGE ug/m^3 (ppm)	ANNUAL AVERAGE ug/m^3 (ppm)	HOURLY AVERAGE ug/m^3 (ppm)	24-HOUR AVERAGE ug/m^3 (ppm)	ANNUAL AVERAGE ug/m^3 (ppm)
Sulphur Dioxide	450 (0.17)	450 (0.17)	150 • (0.06)	30 (0.01)	900 (0.34)	300 (0.11)	60 (0.02)	-	800 (0.30)	-
Hydrogen Sulphide	14 (0.01)	1 (0.001)	-	-	15 (0.011)	5 (0.004)	-	-	-	-
Nitrogen Dioxide	400 (0.21)	-	-	60 (0.03)	400 (0.21)	200 (0.11)	100 (0.05)	1000 (0.52)	300 (0.16)	-
Carbon Monoxide	15,000 (12.9)	15,000 (12.9)	6,000 (5.2) (8-hr)	-	35,000 (30.1)	15,000 (12.9) (8-hr)	-	-	-	20,000 (17.2)
Oxidants	160 (0.08)	-	-	-	-	-	-	-	-	-
Particulates	-	-	-	60 (0.05)	-	120 (0.1)	70 (0.06)	-	400 (0.33)	-
								MAXIMUM ACCEPTABLE LEVEL		
Hydrogen Fluoride	-	-	0.4 (0.0005)	0.2 (0.0003) (7-day)	-	0.85 (0.001)	0.55 (0.0007) (7-day)	0.35 (0.0004) (30-day)	0.20 (0.0003) (70-day)	-
Vinyl Chloride Monomer	26 (0.01)									
Hydrogen Chloride	100 (0.066)									
Chlorine	295 (0.1)									
Ammonia	141 (2)									

III. ALBERTA SURFACE WATER QUALITY OBJECTIVES(3)

Contaminants*	Surface Water Quality Objectives
Biochemical Oxygen Demand	Must not exceed a limit which would create a dissolved oxygen content of less than 5 ppm.
Suspended solids	Not to be increased by more than 10 ppm over background value.
Ammonia nitrogen	Total inorganic and organic nitrogen 1.0 ppm.
Sulphides	0.05 ppm.
Odour	The cold (20° C) threshold odour number not to exceed eight.
pH	Effluent to be in the range of 6.5 to 8.5 units. Receiving stream not to be altered by more than 0.5 unit from background value.
Heavy metals(ppm, acid extractable)	Arsenic (0.01), barium (1.0), cadmium (0.01), hexavalent chromium (0.05), copper (0.02), cyanide (0.01), iron (0.3), lead (0.05), manganese (0.05), mercury (0.0001), selenium (0.01), silver (0.05), zinc (0.05).
Temperature	Not to be increased by more than 3°C above ambient water temperature.
Turbidity	Not to exceed more than 25 Jackson units over natural turbidity.
Dissolved Oxygen	A minimum of 5 mg/l at any time.
Organic Chemicals (ppm)	Carbon chloroform extract (0.2), methyl mercaptan (0.05), methylene blue active substances (0.5), oil and grease (substantially absent, no iridescent sheen), phenolics (0.005), resin acids (0.1).
Pesticides	Should not exceed 1/100 of the 48-hour Tlm. Any pesticides used on, in or near water (within 100 linear feet) must be approved by a Department of Environment permit issued under the Agricultural Chemicals Act.

*THE ANALYTICAL METHODS FOR TESTING THE CONTAMINANTS SHOULD BE REFERRED TO REFERENCE (17).

IV BASIS FOR END OF PIPE DISCHARGES

1 ASPHALT PLANTS(4)

(A) Air Contaminants

particulates	0.2 kg/1000 kgs of flue gas

(B) Water contaminants

No discharge

2 CEMENT MANUFACTURING PLANTS(16)

(A) Air Contaminants

particulates	0.2 kg/1000 kgs of flue gas

(B) Water Contaminants

No discharge

3 COAL MINING(5)

(A) Water Contaminants

Water Contaminant	Discharge Rate
TSS	- 50 ppm maximum absolute or - 10 ppm maximum above the natural background concentration, whichever is greater
pH	6.5 - 9.5
iron (total)	3.5 ppm

(B) Air Contaminants (coal preparation plants)

Particulates	0.2 kg/1000 kgs of flue gas

4 FERTILIZER PLANTS

(A) Water Contaminants(6)

Water Contaminant	Equivalent Concentration* (ppm)	Mass Deposit monthly amount kg/1000 metric tonnes ERAMC/day	Mass Deposit one day amount kg/1000 metric tonnes ERAMC/day	Mass Deposit max. daily amount kg/1000 metric tonnes ERAMC/day
Ammonia-nitrogen	35	105	210	315
Nitrate-nitrogen	20	60	120	180
Organic nitrogen	10	30	60	90
Phosphate (PO_4)	5	15	30	45
Total Suspended Solids	25	75	150	225
Chromium (Hexavalent)	0.3	0.9	1.8	2.7
pH (units)	6.5 - 9.5	6.5 - 9.5	6.5 - 9.5	6.5 - 9.5

*BASED ON MAXIMUM NOMINAL PLANT LIQUID EFFLUENT DISCHARGE RATE OF 3 CUBIC METRES PER METRIC TONNE ERMAC

(ERAMC STANDS FOR EQUIVALENT REFERENCE AMMONIA MANUFACTURING CAPACITY)

(B) Air Contaminants(7)

Type of Plant	Air Contaminant	Emission Level
Sulphuric Acid	SO_2	3 kg/tonne 1 hour average
	SO_3 & Mist as H_2SO_4	0.08 kg/tonne 1 hour average
Nitric Acid	NO_x as NO_2	2.8 kg/tonne 1 hour average
Phosphoric Acid	Soluble Fluorides as HF	0.013 kg/tonne P_2O_5 produced 1 hour average
Urea Synthesis	Free Ammonia	1.3 kg/tonne urea 1 hour average
Urea Prilling or Granulation	Free Ammonia	1.5 kg/tonne urea 1 hour average
	Particulates	0.2 kg/1000 kgs flue gas
Ammonium Nitrate Prilling	Particulates	0.2 kg/1000 kgs flue gas
Ammonium Phosphate	Soluble Fluorides as HF	0.02 kg/tonne of product 1 hour average
	Particulates	0.2 kg/1000 kgs flue gas
Phosphate Rock Grinding	Particulates	0.2 kg/1000 kgs flue gas
Ammonium Nitrate	Free Ammonia	0.5 kg/tonne 1 hour average
	Particulates	0.2 kg/1000 kgs flue gas
Ammonia Synthesis	Free Ammonia	1.5 kg/tonne NH_3 1 hour average

5 FOUNDRIES(1)

(A) Air Contaminants

Source	Particulates
Cupola furnace	
1) less than 12 tonnes/hr. of hot metal.	0.5 kg/1000 kgs of effluent
2) 12 tonnes/hr. of hot metal or more.	0.2 kg/1000 kgs of effluent
Electric arc, Induction, reverbratory furnaces of any size	0.2 kg/1000 kgs of effluent
Non melting operation	0.2 kg/1000 kgs of effluent

6 GAS PROCESSING PLANT(8)

(A) Water Contaminants

Water Contaminant	Emission rate, kg/million cubic metre of raw gas processed	Equivalent Concentration* ppm
COD	16	500
TSS	1.6	50
Sulphide (total)	0.016	0.2
Ammonia nitrogen	0.8	10
Oil and grease	1.6	10
Threshold odour number (units)	100	-
pH	6.5 - 9.5	-
Toxic elements (acid extractable)	- Restriction on the release of the following toxic elements (in ppm) in the plant effluent: arsenic (0.25), barium (1.0), cadmium (0.10), hexavalent chromium, (0.30), copper (1.0), cyanide (0.025), iron (1.0), lead (0.10), manganese (1.0), mercury (0.0005), nickel (1.0), selenium (1.0), silver (0.10), vanadium (1.0), zinc (1.0).	
	- The aggregate total toxic element limit of any individual liquid effluent discharged from a Class C gas plant shall not exceed 5 ppm.	

*BASED ON 100,000 IMPERIAL GALLONS PER DAY DISCHARGED.

(B) Air Contaminants

SO_2	94.5% to 99% sulphur recovery (depending upon the sulphur content of the raw gas)	- for a plant that processes 10 tonnes/day of sulphur in the raw gas or more. - no sulphur recovery is necessary if the plant processes less than 10 tonnes/day of sulphur.

7 KRAFT PULP MILLS[16]

(A) Water Contaminants

BOD_5	11.3 kg/air dried tonne of pulp	- daily river flow greater than 8.5 m^3/second
(equivalent)	9.4 kg/air dried tonne of pulp	- daily river flow less than 8.5 m^3/second
		- based on the average daily mass discharge of water contaminants from the secondary treatment lagoon and production of pulp in air dried tonnes during the same month
TSS (equivalent)	13.9 kg/air dried tonne of pulp	
pH	6.5 - 9.5	- based on a grab sample at any time from the secondary treatment lagoon.
Odour	1,000	- based on a 24-hour composite sample taken at any time from the secondary treatment lagoon
Colour Loading		- based on best practicable technology

(B) Air Contaminants[18]

Particulates	0.2 kg/1000 kgs of flue gas	- from all sources
SO_2	30 ppmv (4-hr average)	- discharged from the lime kiln effluent stream
	500 ppmv (4-hr average)	- discharged from recovery boiler stack effluent stream
TRS	150 grams/tonne of air dried pulp produced	- discharged from the recovery boiler kiln
	225 grams/tonne of air dried pulp produced	- discharged from the combined lime kiln, smelt dissolving tank, brown stock washer and black liquor oxidation operations.
		- TRS: total reduced sulphur which means the sum of the sulphur compounds, hydrogen sulphide, methyl mercaptan, dimethyl sulphide and dimethyl disulphide.

8 MEAT PACKING AND PROCESSING PLANTS(9)

(A) Wastewater disposal alternatives

1 primary or secondary pretreatment required before discharge to municipal sewage treatment plant (the municipality dictates the pretreatment option)

2 spray irrigation

- with a minimum storage period of seven months
- controlled spray irrigation such as on specific land parcels only during the period of crop growing season, no surface runoff entering any surface waterbody and minimized contamination of ground water aquifier

3 discharge to receiving streams

	Water Contaminants	Authorized actual daily deposit	Authorized average daily deposit during an equivalent month	Remarks
3.1 RED MEAT INTEGRATED PLANT	BOD_5	1.0 kg/tonne*	0.5 kg/tonne	includes any plant that slaughters and dresses meat other than poultry.
	TSS	1.2 kg/tonne	0.6 kg/tonne	*per tonne of finished product.
	grease	1.6 kg/tonne	0.8 kg/tonne	
	pH	6.0 - 9.0	6.0 - 9.0	
	acute lethal toxicity (LC_{50})	50%		

	Water Contaminants	Authorized actual daily deposit	Authorized average daily deposit during an equivalent month	Remarks
3.2 PROCESSING PLANT	BOD_5	0.7 kg/tonne*	0.35 kg/tonne	includes any plant that is not an integrated plant that performs operations subsequent to slaughtering and dressing but does not include rendering plants
	TSS	0.5 kg/tonne	0.25 kg/tonne	
	grease	0.8 kg/tonne	0.4 kg/tonne	*per tonne of finished product
	pH	6.0 - 9.0	6.0 - 9.0	
	acute lethal toxicity (LC_{50})	50%		
3.3 POULTRY INTEGRATED PLANT	BOD_5	1.4 kg/tonne*	0.7 kg/tonne	includes any plant that slaughters and dresses poultry
	TSS	1.0 kg/tonne	0.5 kg/tonne	*per tonne of finished product
	grease	1.0 kg/tonne	0.5 kg/tonne	
	pH	6.0 - 9.0	6.0 - 9.0	
	acute lethal toxicity (LC_{50})	50%		
3.4 RENDERING PLANT	BOD_5	0.4 kg/tonne*	0.2 kg/tonne	includes any plant that performs operations solely for the purpose of edible or inedible rendering of meat or poultry products, with or without oil refining
	TSS	0.4 kg/tonne	0.2 kg/tonne	
	grease	0.3 kg/tonne	0.15 kg/tonne	
	pH	6.0 - 9.0	6.0 - 9.0	*per tonne of raw material
	acute lethal toxicity (LC_{50})	50%		

9 ORGANIC CHEMICAL PLANTS[10]

(A) Water Contaminants

Water Contaminant	kg/tonne (monthly average)	kg/tonne (max. daily)
Total organic carbon	1.5	4.5
Total Kjeldahl nitrogen	0.4	1.2
TSS	1.0	3.0
pH (units)	6.0 - 9.5	6.0 - 9.5

(B) Air Contaminants

Particulates	0.2 kg/1000 kgs of effluent gas
Odour	Best practicable technology (e.g., incinerator or multistage scrubber) be used for at least 90% removal of odour causing compounds.

10 VINYL CHLORIDE AND POLYVINYL CHLORIDE PLANTS

(A) Air Contaminants[1]

vinyl chloride	-	10 ppmv in an effluent	measured on a dry and undiluted basis
	-	0.002 kg/100 kgs of PVC produced	reactor opening loss
	-	0.02 kg/100 kgs of PVC produced	in the manufacture of suspension homopolymer resin
	-	0.04 kg/100 kgs of PVC produced	in the manufacture of bulk resin
	-	0.2 kg/100 kgs of PVC produced	in the manufacture of copolymer resins

(B) Water Contaminant[16]

	Mass Discharge	Average Mass Discharge
Total organic carbon	0.23 kg/tonne of product	0.077 kg/tonne of product
VCM	0.013 kg/tonne of product	0.0042 kg/tonne of product
TSS	0.15 kg/tonne of product	0.05 kg/tonne of product
chloride	-	0.87 kg/tonne of product

11 POWER PLANTS

(A) Water Contaminants[16]

The discharge of process wastewater from the plant is limited to boiler blowdown, cooling water, and demineralizer and mixed-bed regenerant wastewater. The discharge is subject to the following conditions:

free available chlorine residual	0.2 ppm
TSS	50 ppm or 10 ppm above the background level, whichever is the greater
pH	6.5 - 9.5
oil and grease	5 ppm
total phosphorus	2 ppm

(B) Air Contaminants[11]

SO_2	a) No SO_2 removal for uncontrolled emissions less than 258 ng/J of heat input. b) 258 ng/J for uncontrolled emissions between 258 and 2580 ng/J of heat input. c) 90% SO_2 removal for uncontrolled emissions greater than 2580 ng/J of heat input.
particulates	43 ng/J of heat input when fired with solid fuels.
NO_x (as NO_2)	a) 258 ng/J of heat input (when fired with solid fuels). b) 129 ng/J of heat input (when fired with liquid fuels) c) 86 ng/J of heat input (when fired with gaseous fuels)

12 REFINERIES

(A) Water Contaminants(12)

(a) refineries with disposal well capability

Water Contaminant	Monthly Amount kg/1000 m^3	One Day Amount kg/1000 m^3	Max. Daily Amount kg/1000 m^3	*Average Concentration levels, ppm
Chemical Oxygen Demand	110	205	277	200
Oil and Grease	5	10	14	10
Total Suspended Solids	13	22	27	25
Phenols	0.55	1.03	1.39	1
Sulphide	0.18	0.55	0.91	0.35
Ammonia Nitrogen	6.65	10.81	13.30	12.5
Threshold Odour Number (units)	300	400	800	-
pH (units)	6.0 - 9.5	6.0 - 9.5	6.0 - 9.5	-
Chromium (hexavalent)	-	-	-	0.3
Cyanide	-	-	-	0.025
Lead	-	-	-	0.1
Mercury	-	-	-	0.0005
Nickel	-	-	-	1.0
Zinc	-	-	-	1.0

*NOTE: Average concentration levels obtainable by "best practicable control technology" based on a nominal effluent flow rate of 0.372 m^3/min per 1000 m^3 of crude oil processed.

(A) Water Contaminants (cont'd)
(b) refineries without disposal well capability

Water Contaminant	Monthly Amount kg/1000 m^3	One Day Amount kg/1000 m^3	Max. Daily Amount kg/1000 m^3	*Average Concentration levels, ppm
Chemical Oxygen Demand	166	305	415	200
Oil and Grease	8	15	20	10
Total Suspended Solids	20	33	41	25
Phenols	0.83	1.52	2.08	1.0
Sulphide	0.28	0.83	1.39	0.35
Ammonia Nitrogen	9.98	15.80	19.96	12.5
Threshold Odour Number (units)	450	600	1200	-
pH (units)	6.0 - 9.5	6.0 - 9.5	6.0 - 9.5	-
Chromium (hexavalent)	-	-	-	0.3
Cyanide	-	-	-	0.025
Lead	-	-	-	0.1
Mercury	-	-	-	0.0005
Nickel	-	-	-	1.0
Zinc	-	-	-	1.0

*NOTE: Average concentration levels obtainable by "best practicable control technology" based on a nominal effluent flow rate of 0.556 m^3/min per 1000 m^3 of crude oil processed.

(B) Air Contaminants[16]

Particulates	0.2 kg/1000 kgs of flue gas	from all sources
SO_2	0.66 tonne/1000 m^3 of crude oil processed	from all sources
CO	1000 ppmv	from fluid catalytic cracking unit
Volatile Organic Compounds	Emission from hydrocarbon storage facilities should be controlled by either a floating roof or an equivalent vapor recovery system for tanks over 15 meter diameter and vapor pressure of 21 to 86 kpa. All stocks with a vapor pressure over 86 kpa should be stored in pressurized vessels.	

13 REFUSE INCINERATORS(13)

(A) Air Contaminants

HCl	stack concentration 100 ppm on a dry basis and corrected to 50% excess air
Particulates	0.2 kg/1000 kgs of flue gas (for capacity greater than 500 pounds per hour)
	* 0.6 kg/1000 kgs of flue gas (for capacity less than 500 pounds per hour)
Visible Emission	should not exceed an opacity of 20% averaged over a period of six consecutive minutes.

14 SECONDARY LEAD SMELTERS(1)

(A) Air Contaminants

particulates	0.046 gm/m^3 for particulates 0.029 gm/m^3 for lead in particulates	from operations involving blast furnaces, cupolas, or reverberatory furnaces
	0.023 gm/m^3 for particulates 0.014 gm/m^3 for lead in particulates	from operations involving holding furnaces, pot furnaces or any other melting or refining operations

15 SEWAGE TREATMENT PLANT[14]

(A) Water Contaminants

A.1 Criteria for Secondary Treatment (Including Aerated Lagoons)

Contaminants	Effluent Value
Ammonia Nitrogan	10 - 20 mg/1
BOD (5-day @ 20 degrees C)	15 - 30 mg/1
Coliform Bacteria	20,000 - 200,000 /100 ml
Methylene Blue Active Substances	0.2 - 0.8 mg/1
Dissolved Oxygen	3 - 5 mg/1
Oil and Grease (Ether solubles)	15 - 25 mg/1
pH	5.5 - 10.5
Phenolics	20 - 40 ppb
Suspended Solids	15 - 30 mg/1
Phosphorus as PO_4	15 - 30 mg/1
Temperature	- Not to be increased by more than 3 degrees C above ambient water temperature.
Odour	- The cold (20 degrees C) threshold odour number not to exceed eight.
Colour	- Transmittance not to be decreased more than 30% below natural value.
Turbidity	- Not to exceed more than 25 Jackson units over natural turbidity.

15 SEWAGE TREATMENT PLANT(14)

(A) Water Contaminants (cont'd)

A.2 Criteria for Conventional Aerobic Lagoons

Contaminant	Effluent Value
BOD (5-day @ 20 degrees C)	15 - 30 mg/l
Coliform Bacteria	20,000 - 200,000/100 ml
Methylene Blue Active Substances	0.2 - 1.5 mg/l
Suspended Solids	15 - 100 mg/l
Algae	150 - 300 ppm (vol.)
Phosphorus as PO_4	5 - 20 mg/l

A.3 Other Requirements

Disinfection	Disinfection of the sewage treatment plant effluent will be required where a public health hazard may be created by the effluent discharge. Fical coliform count for the disinfected sewage effluent is 200/100 ml
Phosphorus	Site specific requirement is 1 mg/l, based on receiving stream eutrophication consideration.
Drainage Course	The minimum average monthly flow in the stream must be a minimum of ten times the average daily flow of sewage effluent discharged to that stream.

16 TAR SANDS PLANTS(15)

(A) Water Contaminants

Zero discharge except for depressurization water release. Wastewater to be totally contained in ponds

(B) Air contaminants

SO_2	3.2 tonne/1000 m^3 bitumen feed to upgrading	
	10 tonnes per day per single operation	- in-situ heavy oil recovery operation
Particulates	0.2 kg/1000 kgs of flue gas	

V. REFERENCES

1 Clean Air (Maximum Levels) Regulation, Alberta Regulation AR 218/75 with Amendments up to and including Alberta Regulation 319/79.

2 "Criteria for National Air Quality Objectives", Federal-Provincial Committee on Air Pollution, Environment Canada, November, 1976.

3 "Alberta Surface Water Quality Objectives", Alberta Environment, January, 1977.

4 "Environmental Control Guidelines for Asphalt Paving Plants", Alberta Environment, March, 1977.

5 "Alberta Coal Mining Wastewater Effluent Guidelines", Alberta Environment, January, 1978.

6 "Wastewater Effluent Guidelines for Alberta Fertilizer Plants", Alberta Environment, October, 1976.

7 "Guidelines for Limiting Contaminant Emissions to the Atmosphere from Fertilizer plants and related Industries in Alberta", Alberta Environment, February 1976.

8 "Gas Processing Plants - Wastewater Management Standards", Alberta Environment, September, 1973.

9 "Meat and Poultry Products Plant Liquid Effluent Regulations and Guidelines", Environment Canada, EPS 1-WP-77-2, July, 1977.

10 "Organic Chemical Regulations and Guidelines", Draft #9, Environment Canada, July, 1978.

11 "Thermal Power Generation Emissions - National Guidelines for New Stationary Sources", Environment Canada, April 1981.

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12 "Wastewater Effluent Guidelines for Alberta Petroleum Refineries", Alberta Environment, August, 1976.

13 "Packaged Incinerators National Emission Guidelines", Enviroment Canada, November, 1978.

14 "Recommended Standards for Water Supply and Sewerage", Alberta Environment, April, 1978.

15 "Report on Syncrude Canada Limited", Prepared by Federal-Provincial Air/Atmospheric Committee, Environment Canada and Alberta Environment, March, 1978.

16 Site Specific Conditions Based on Best Practicable Technology.

17 "Standard Methods for The Examination of Water and Wastewater", 14th Edition, prepared and published by American Public Health Association, American Water Works Association and Water Pollution Control Federation, 1976.

18 "Wood Pulping Industry National Emission Guidelines for New Stationary Sources", Environment Canada, The Canada Gazette Part I, September, 1979.

19 "Guidelines for Plume Dispersion Calculations", Alberta Environment, May, 1978.